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## A NEW APPROACH TO RESECTION OF CANCER OF THE COLONIC FLEXURES\*

By CARL L. HOAG, M.D.  
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DISCUSSION by H. Glenn Bell, M.D., San Francisco; Mark Lewis Emerson, M.D., Oakland; Harold Brunn, M.D., San Francisco; John B. deC. M. Saunders, F.R.C.S., San Francisco.

CARCINOMA involving the splenic and hepatic flexures has too frequently been regarded as inoperable because of the difficulties of resection and the high mortality occasioned by the removal of this portion of the bowel. For this reason many palliative operations have been done. Permanent colostomies are necessary at times, but they have many objectionable features, and should be avoided if reestablishment of the continuity of the bowel is at all possible without too great a risk.

### DIFFICULTIES AND DANGERS OF RESECTION

The difficulties and dangers of resection have been caused largely by the poor exposure through the usual anterior route, making the operation long and subjecting the patient to shock; in addition, the flexures are fixed and inaccessible, the blood supply comes from the posterior wall still farther from the incision, and it is often impossible to remove completely the glandular metastases in the surrounding tissues. If the patient survive the immediate operation, too frequently he is left with a permanent colostomy or fistula, and eventually dies of infection or a recurrence of the disease.

Some of our surgeons argue that a permanent colostomy can be made so inoffensive that it is not objectionable. It is always, however, a source of great care, gives an unmistakable odor however perfectly it may function, and leaves the patient with a physical handicap and mental distress.

We do not hesitate to resect a cancer of the stomach even in the presence of known metastases in the liver, and in spite of a fairly high mortality rate, because, without resection, patients with this lesion lead a miserable existence; on the other hand, if resection is successful they may live fairly comfortably for from one to five years. In my opinion we should adopt a similar attitude toward cancer of the colon.

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Read before the General Surgery Section of the California Medical Association at the sixty-fifth annual session, Coronado, May 25-28, 1936.

The transverse incisions through the rectus muscle or the combined rectus and costal incisions have never become popular as a method of opening the abdomen, because of the time consumed in closure and because the wall is weakened in a high percentage of cases due to interference with the nerve supply, or infection. The lumbar incision of Koster,<sup>1</sup> "extending from the tip of the twelfth rib to the anterior-superior spine," approaches the mesenteric vessels from the retro-peritoneal space, and gives a fairly good approach to the blood supply but does not give adequate exposure for a rapid and complete excision.

### INCISION USED BY THE AUTHOR

I have been using a pericostal-transabdominal incision which parallels the twelfth rib and extends from the lumbar fascia in the back to the sheath of the rectus abdominis muscle in front, at the level of the umbilicus—a modification of the usual incision for exposure of the kidney. Instead of curving downward toward the groin, the incision curves upward around the tip of the twelfth rib, extends to and nicks the sheath of the rectus muscle, but does not transect the muscle itself. If it interferes with the innervation of the musculature at all it is only to a slight degree.

It would seem that this incision should violate every principle of good surgery by dividing both muscle fibers and their nerve supply, which would make herniation inevitable. This, however, is not the case. The recent work of Coyte,<sup>1</sup> and Davies, Gladstone and Stibbe,<sup>2</sup> has shown that the eleventh intercostal nerve does not course directly across the abdomen, as our anatomies have taught us, but first loops downward before entering the rectus muscle just above the umbilicus, and then again turns downward within its fibers. The lower dorsal nerve (subcostal or twelfth nerve) does not follow the twelfth rib, but comes out much lower and nearer the spine, with the ilio-inguinal and iliohypogastric nerves, and after looping downward, enters the rectus muscle below the umbilicus and courses downward. This incision is made between and parallel to the eleventh and twelfth nerves, which explains the lack of injury to the nerves and lack of degeneration of the muscles which we have found in actual practice. It may be of interest that this incision was developed and used successfully before the true anatomic arrangement—which explains its anatomic soundness—was suspected.

Formerly we were taught that each segment of the rectus muscle was innervated by a single nerve, and that severance of that nerve would result in atrophy of the corresponding segment. In actual practice, however, this complication was seldom seen. An explanation of this fact is offered in the work of Davies, Gladstone and Stibbe,<sup>2</sup> who stated, in a recent article: "Moreover, any one nerve at the lateral border of the rectus is distributed to two segments of muscle. It is certain, therefore, that the rectus segments do not receive a segmental nerve supply, but that each segment is supplied by three segmental nerves at least." Goinard<sup>3</sup> also suggested that the nerve

fibers actually cross the linea alba of the rectus muscle. So far this lacks proof.

#### TECHNIQUE OF OPERATION

A table with a kidney lift is necessary for this procedure. The patient is placed on his sound side with the leg on that side extended, the other leg flexed, the body tilted slightly backward and the back supported on sand bags. This position is the reverse of that used for exposure of the kidney. The skin incision extends from the juncture of the twelfth rib with the spine, to the outer border of the rectus muscle at the umbilicus. The external and internal oblique and transversalis muscles are divided without regard for the direction of their fibers. The anterior portion of the latissimus dorsi muscle is transected and the lumbar fascia divided. Anteriorly, the incision extends into the fascia of the rectus muscle, and the anterior and posterior leaves are partially divided. The nerve supply entering the rectus muscle is readily seen and avoided. The peritoneum is opened widely and the kidney lift is elevated. This, the elevation of the kidney lift, is the most important single step of the operation, for it is the means by which adequate exposure is secured. It more than doubles the normal distance between the twelfth rib and the iliac crest by opening the incision like the spreading of a mouth, and at the same time it tilts the costal margin upward, bringing the colon with its flexure into view. The intestines fall away and seldom show any tendency to bulge out of the wound, so that packs are required only for walling off the intestinal cavity. The space is, in fact, so wide that a Balfour retractor spread to its greatest extent will not remain in position.

On the right side this incision allows ready access to the cecum, ascending colon, hepatic flexure and the right half of the transverse colon. On the left side it exposes the descending colon, splenic flexure and the left half of the transverse colon. It permits a fair exposure of the spleen.

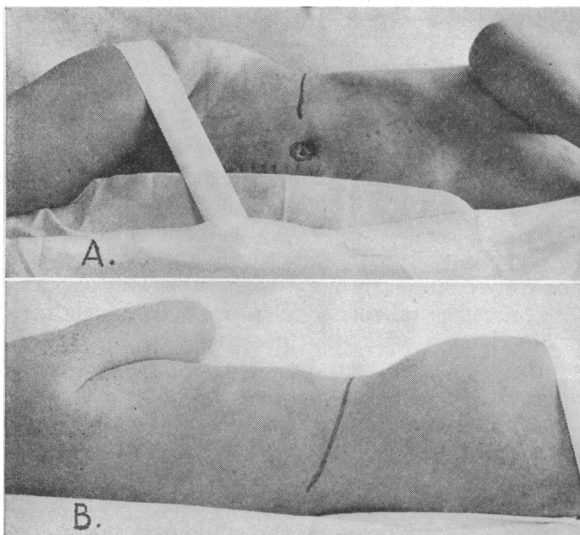


Fig. 1.—Position of patient on table, back supported by sand bags. Line of incision. (Kidney lift is raised *after* incision is made.)

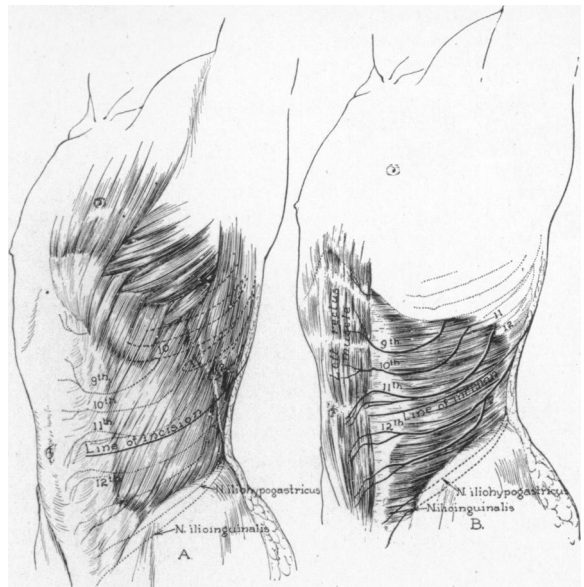


Fig. 2.—Course and distribution of the abdominal nerves. Line of pericostal-transabdominal incision between eleventh and twelfth nerves.

According to Ewing's statistics of 297 cases of carcinoma of the colon, exclusive of lesions of the rectum, the following disposition was found: cecum, 47; ascending colon, 22; hepatic flexure, 19; transverse colon, 44; splenic flexure, 31; descending colon, 10; sigmoid colon, 124. Of these, at least 129, or 43 per cent, could best be approached through the incision described.

The great majority of malignant lesions of the colon are not diagnosed as such, nor are they localized until obstruction occurs. Once the lesion is localized our procedure has become pretty well standardized.

A two-stage operation has been found to reduce the mortality greatly, first, by relieving the obstruction, if present; secondly, by allowing for improved nutrition; thirdly, by vaccinating the patient so that the reaction to infection in the second stage of the operation is minimized; and fourthly, by reducing the magnitude of any one single operative procedure. The possible exception to the two-stage operation is the Mikulicz technique which, when indicated, may be done in either one or two stages.

#### RESECTION OF THE LESION

The first stage, done commonly through a rectus or McBurney incision, has a two-fold purpose.

First, an exploration to determine the position and extent of fixation of the lesion, and whether or not metastases are present; and, secondly, a decompression of the bowel, either by a side-tracking anastomosis or by some type of colostomy. On the right side an anastomosis (usually side to side) of the lower ileum to the transverse colon is the procedure of choice, with or without transection of the distal ileum. On the left side, the situation is more complicated. If the lesion is near the splenic flexure it is a temptation to sidetrack the contents of the bowel by an anastomosis of the transverse colon to the descending colon,

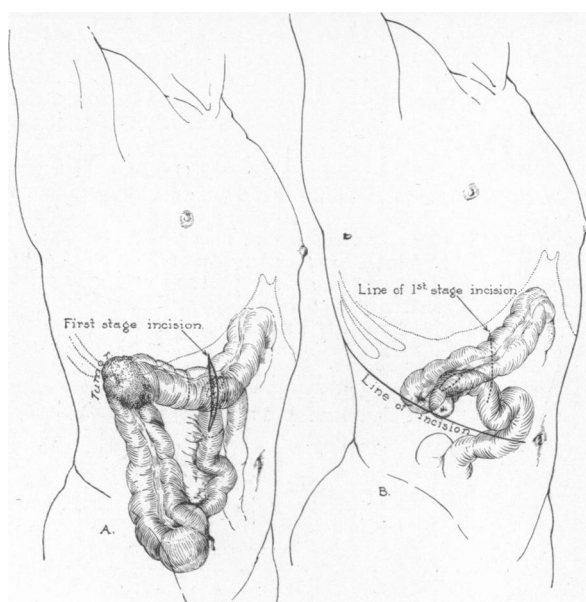


Fig. 3

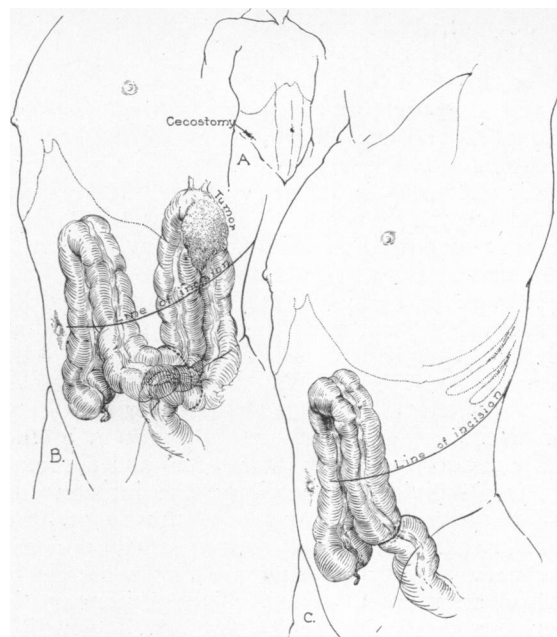


Fig. 4

Fig. 3.—Schematic drawing of procedure for lesions of the right side. (a) First stage operation through right rectus incision with an ileo-transverse colostomy. (b) Second stage pericostal-transabdominal incision with resection of terminal ileum, cecum, ascending colon and first portion of transverse colon.

Fig. 4.—Schematic drawing of lesions of left side. (a) First stage. High McBurney cecostomy (or colostomy if preferred). (b and c) Choice of these two procedures is optional. (b) Pericostal-transabdominal incision, lateral anastomosis with or without resection of tumor. (c) Pericostal-transabdominal incision with resection of tumor and end-to-end anastomosis.

or sigmoid. Too many complications, however, arise from any primary anastomosis to the descending colon or sigmoid, and the mortality rate from this procedure ranges from 25 to 50 per cent. A preliminary cecostomy or colostomy proximal to the lesion makes such an anastomosis much safer, by decompressing the bowel and vaccinating the patient against infection. A cecostomy is more readily closed whenever it becomes necessary to reestablish the continuity of the bowel, but it seldom diverts the intestinal stream satisfactorily unless obstruction is present. If there is no obstruction a colostomy is preferable.

Some writers advocate a so-called "blind" cecostomy when obstruction is present. The operation is done through a high McBurney incision under local anesthesia, and without any attempt at exploration. While this may be the procedure of choice in certain depleted patients, it leaves the operator in doubt as to the nature and magnitude of the subsequent operation. There is usually no contraindication to exploration of the abdomen in chronic obstruction, even though it requires general anesthesia, and frequently it can be done satisfactorily through the McBurney incision, which is to be used for the cecostomy.

In the second stage, the abdomen is opened through the pericostal-transabdominal incision described above, and the intestines are packed off. The posterior layer of the peritoneum along the mesentery is divided and the ureter located. If the lesion is on the right side the ileo-colic branches to the terminal ileum and the right colic artery are clamped and ligated, and the mesentery with its vessels is divided so that the bowel is released. The suspensory ligament (hepato-colic) is severed and with this the entire flexure falls downward and can be lifted out of the wound. Care must be taken not to injure the right kidney or duodenum when the mesentery is divided. If a previous ileo-transverse colostomy has been done the entire cecum, ascending colon and a portion of the transverse colon, with any metastases present, are then removed and the end of the gut is closed in the usual manner.

On the left side the second stage procedure is similar. After opening the abdomen through a pericostal-transabdominal incision, the peritoneum is opened along the descending colon, the left colic artery is ligated and the mesentery is divided. In-

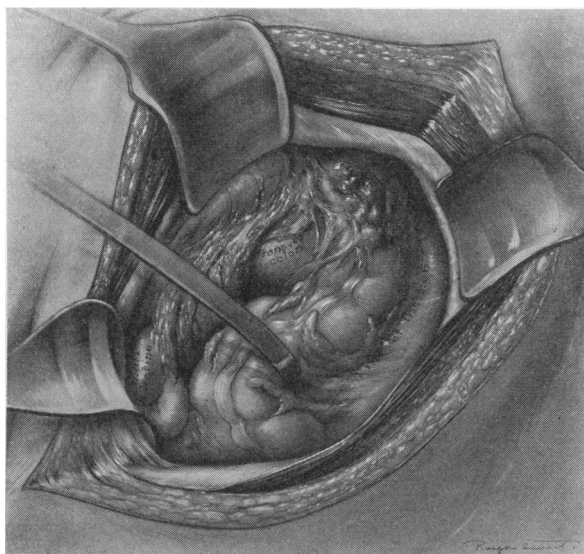


Fig. 5.—Left pericostal-transabdominal incision spread open by elevation of kidney lift showing splenic flexure, descending colon, with line of incision in mesentery.

volved lymph glands are removed with the mesentery. The phreno-colic ligament is cut, liberating the flexure. Injury to the spleen, pancreas, stomach and kidney must be avoided. A lateral anastomosis between the transverse colon and the descending colon or sigmoid may be done, followed by removal of the lesion and closure of the ends of the gut; or preferably the lesion may be released and removed, and an end-to-end anastomosis done. In my experience the end-to-end anastomosis is a shorter and more satisfactory procedure. It can be done by the usual open method, but the use of the Furniss clamp and pin has proved to be more rapid, aseptic and generally more satisfactory than any method which I have used up to this time. In any end-to-end anastomosis it is important to note carefully whether or not the blood supply to the remaining stump is adequate before selecting the site for transecting the bowel, and the longitudinal bands should be approximated as far as possible. Any disproportion in the diameter of the two segments of gut to be anastomosed is overcome by slanting the line of transection of the smaller one. I have used interrupted black silk mattress sutures for the inner layer of this anastomosis, with a running catgut suture covering it, or interrupted black silk throughout. The large bowel tolerates silk very well, and little difficulty may be expected if an interrupted type of suture is used. The opening in the mesentery is either closed tightly to prevent herniation of the intestine, or if it does not come together well it should be left wide open and no attempt made to close it.

#### CLOSURE OF THE INCISION

The kidney lift is lowered, allowing the edges of the incision to fall together. The peritoneum is closed with a continuous suture, and each muscular layer is brought together with interrupted

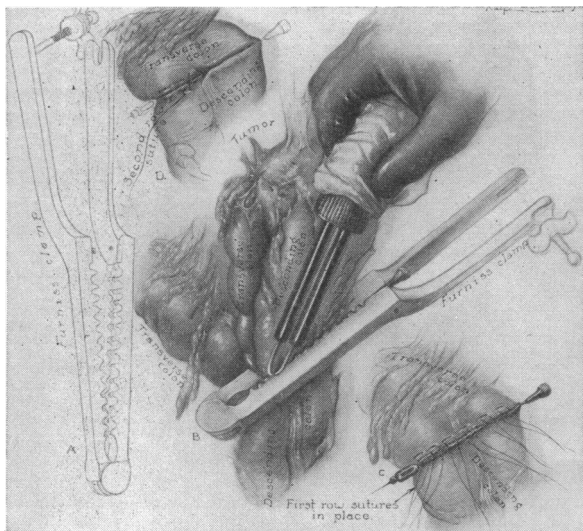


Fig. 6.—(a) Furniss clamp showing serration in teeth for passage of pin. (b) Application of Furniss clamp to both loops of splenic flexure. (The pin must be inserted before the loop is removed with the cautery.) (c) Both loops of gut held by pin with guard and first row of sutures. (d) A second row is supplied. The anastomosis is then rotated 180 degrees and the same suturing technique completed before the pin is withdrawn.

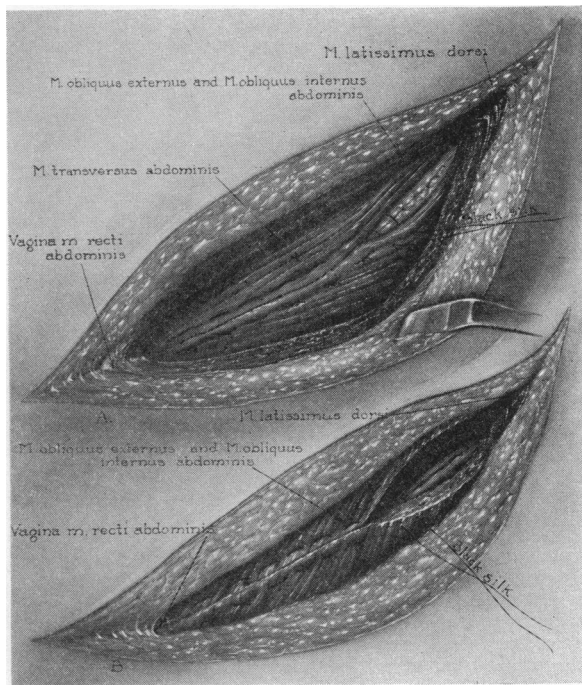


Fig. 7.—Closure of peritoneum with continuous sutures; closure of muscle layers with interrupted everting sutures. External and internal oblique and latissimus dorsi transected, transversalis split, rectus abdominis muscle fibers exposed.

mattress sutures, everting the edges. In some of my patients closure has been made with silk, but catgut has been used in the more infected. For those who have shown the greatest amount of infection or inadequate hemostasis of the vessels in the muscle, drainage for forty-eight hours has been instituted by means of a rubber-dam wick inserted down to the peritoneum, or between the muscular layers, and brought out through the posterior angle of the incision for dependent drainage. This places the opening for drainage over the erector spinae muscles.

Once the incision is closed there is little strain upon it, as distension of the abdomen tends to pull the edges of the muscle together rather than to separate them. This in itself is an important factor in preventing herniation.

#### REPORT OF CASES

Two typical cases selected from a series of ten.

CASE 1.—Mrs. M. P. B., aged 46 years, was seen first on June 15, 1934. For at least two months the patient had had indefinite pains in the abdomen, with considerable rumbling and evidence of an incomplete obstruction. Roentgen examinations of the gastro-intestinal tract had been made, but no obstruction was noted. While in another city the patient had so much pain that additional x-ray examinations were made, but, again, no definite point of obstruction was found. On her return to San Francisco, obstruction was nearly complete, a barium enema failed to pass beyond the hepatic flexure, and gas-filled bowel could be seen proximal to this point.

Exploration was done through a right rectus incision on June 16, 1934. Little could be seen in the abdomen except dilated small bowel and ascending colon. Palpation of the hepatic flexure showed a small annular constriction. The mass, apparently a carcinoma, was very small, and certainly would have been overlooked in any exploratory operation had not the point of obstruction been known. A lateral anastomosis was made between the ter-

minal ileum, some fourteen inches from the cecum, and the transverse colon. The patient made an uneventful recovery, and normal bowel habit was reestablished. The lesion was so far from the incision made for the exploration that it seemed quite impossible to remove it through any type of right rectus incision.

Four weeks later a pericostal-transabdominal incision was made. The kidney lift was elevated, and the entire ascending colon and flexure could be seen and palpated. The ilio-colic and right colic vessels were identified and ligated, and the entire cecum, ascending colon and one-third of the transverse colon were liberated. One metastatic gland was found in the mesentery and removed with it. The bowel was divided with the cautery proximal to the original anastomosis, and removed. The ends were closed with inversion sutures. The patient's recovery was uneventful; there was no interruption of bowel habit and there was little shock connected with the operation. The pathological diagnosis was adenocarcinoma.

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CASE 2.—Mrs. F. B., aged 38 years, was seen first on August 16, 1935. The patient had had symptoms of a partial obstruction for a number of months, and had had an appendectomy without relief. As time went on she developed an obstruction, and exploration revealed a lesion at the splenic flexure. A transverse colostomy was done on the right side. Three weeks later, her condition having improved, the abdomen was opened through a left pericostal-transabdominal incision. A rather large lesion, completely surrounding the bowel and with some metastases in the mesentery, was found. Beginning distal to the lesion the mesentery, with the involved glands, was dissected free and the entire mass released. The transverse colon was then approximated to the descending colon with the longitudinal bands in approximation, the loop was crushed with the Furniss clamp and fixed with the pin, and the lesion was removed with a cautery. An end-to-end anastomosis was done over the pin with an inner layer of mattress silk sutures and an outer layer of gastro-intestinal catgut. The peritoneum was then closed and, because of possible soiling, a rubberdam drain was inserted down to the peritoneum. The wound healed very well, but there was a considerable amount of infection and drainage. In spite of this, the wall became firm. Three weeks later the colostomy was deepened and closed. At this time a finger was inserted through the drainage channel of the pericostal-transabdominal incision and it was found to lead into muscle, and to be surrounded by very firm wall.

Recovery was uneventful and a barium enema on March 6, 1936, showed no evidence of recurrence of the lesion and no indication of the point at which the anastomosis had been made. The pathological diagnosis was adenocarcinoma.

The other eight cases operated by this technique are so similar that they are not reported in detail.

#### SUMMARY

1. A new method of operative approach by a pericostal-transabdominal incision parallel to the actual nerve supply gives an excellent exposure of the colon and its flexures, and permits their more rapid and complete removal.

2. The use of this incision permits resection and reestablishment of continuity of the bowel rather than a permanent colostomy for a greater number of patients. It is hoped that the procedure will be a potent factor in reducing the morbidity and mortality of certain lesions of the colon.

3. Recent investigations of the innervation of the abdominal and rectus muscles have shown it to be different from that long accepted by our older anatomists.

384 Post Street.

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#### DISCUSSION

H. GLENN BELL, M. D. (University of California Hospital, San Francisco).—Doctor Hoag has devised a very interesting approach to the flexures of the large bowel. We have used it at the University of California Clinic on several occasions and find that we get a thoroughly adequate exposure—one which is superior to that afforded by either a right or a left rectus incision. It permits us to protect the edges of the wound so that, even if we do an open anastomosis of the large bowel, we may anticipate having the wound heal per primum. This has been the result on several occasions.

It is always interesting to have someone refresh our memories as to the anatomical structures of the abdominal wall, particularly the nerve supply. The making of the incision described requires, perhaps, a little more time than the usual type of incision—particularly if one is careful to obtain adequate hemostasis. The time spent in opening the abdomen, however, is more than justified by the ease with which the required surgical procedure can be accomplished. Through this approach we have been able to resect the tumor and do an end-to-end anastomosis. We do not, of course, do this in one stage. In each instance we have done at least a cecostomy many days before.

Doctor Hoag is to be commended for bringing before us this incision for use in selected cases.

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MARK LEWIS EMERSON, M. D. (1624 Franklin Street, Oakland).—In discussing the incision which has been so ably presented to you today, allow me to refer you to Gray's Anatomy, which shows a plate of the inner surface of the posterior abdominal wall after the colon has been removed. You will then see how deep and how close to the spine the two flexures of the transverse colon are situated. It is the surgical approach to this difficult position that is so greatly facilitated by the incision devised by Doctor Hoag. Lesions in either flexures of the colon are not amenable to enucleation and any attempt at the same, especially in the presence of inflammation or extensive pathology will favor operative perforation of the bowel, the most common cause of peritonitis in this type of surgery.

The mesenteric attachments of the colonic flexures must be cut around, either by knife or scissors, including the posterior peritoneum, before mobilization and delivery of the tumor can be accomplished.

The incision advocated by Doctor Hoag not only facilitates this dissection, but also gives a quick approach to various organs in the upper quadrant of the abdomen such as emergency wounds of the spleen, kidney and bowel. Some operators are making the incisions too low, others are attempting to include the author's incision as a lateral extension from the vertical rectus incision whenever the latter is inadequate. Doctor Hoag takes advantage of the decreased shock resulting from the use of a table lift to spread the incision, but he has no objection to retention retractors when the operator deems it necessary. The wide field given by this incision is often all that is necessary to make a lateral posterior approach to the upper angulations of the large bowel.

Doctor Hoag has been working many months on this incision, giving his time to instruct other operators how to use it, and all operators that I have seen use this incision have been most enthusiastic because of benefits derived.

I congratulate Doctor Hoag on his perseverance and his patience in so thoroughly trying out this work before presenting it to you today, also allowing the judgment of others to assist him in his final conclusions.

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HAROLD BRUNN, M.D. (384 Post Street, San Francisco).—Doctor Hoag is to be congratulated on developing a new incision which gives a great deal of room and easy working space in the upper abdomen on either the right or left side. There has been a tendency toward transverse abdominal incisions for some time. This type of incision seems to have the habit of becoming popularized and then disappearing from view and being rediscovered.

The incision of Doctor Hoag's, however, is somewhat different and does give access to a region which is very difficult to reach with the ordinary longitudinal incision through the right rectus.

It is not unusual in abdominal operations, when an exploration has been made through the right rectus, to find it necessary to make a transverse incision either to the left or right in order to obtain more room. Doctor Hoag, however, has developed this operation to its greatest extent and shows how, if properly made and extensive enough in the back, a longitudinal incision is not necessary. I am sure that this method of approach should always be considered when any mass is to be removed either from the right or from the left side, especially those that may be retroperitoneal or for large tumors involving either kidney.

The pictures which illustrate the article are exceedingly good and should be carefully studied in order that the incision developed by Doctor Hoag should be used as described.

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JOHN B. DEC. M. SAUNDERS, F. R. C. S. (University of California Medical School, San Francisco).—The approach devised by Dr. Carl Hoag for resection of cancers involving the colonic flexures is a distinct and valuable contribution to surgery. There can be little question that an approach of this type is, in view of its directness, the most logical procedure for exposure of the flexures, which structures are deeply placed in the flanks; in the wide hollows on either side of the prominent bodies of the lumbar vertebrae. The problem raised by such an approach is the question as to whether or not the essential nerve supply of the musculature can be preserved in order to maintain the integrity of the abdominal parietes. Our conception of the course and distribution of the intercostal nerves has undergone considerable changes from those which are to be found in the standard textbooks of anatomy. Doctor Hoag has mentioned the recent work of Davis, Gladstone and Stibbe on the intercostal nerves, which merits the close attention of all those who are interested in problems of abdominal approach. We have been able to confirm for the most part the findings of these authors, findings which indicate that this route is anatomically sound. There can be little question that an approach of this type secures the most adequate exposure of the colon that it is possible to obtain. The position of the patient is an additional advantage in that the abdominal contents are carried out of the way and do not obstruct the field.

The dictum that the surgery of carcinoma of the large bowel is dependent upon its lymph drainage and vascular supply has now become axiomatic. An approach which enables us to reach with ease the vessels of the colon, to mobilize the bowel and to perform wide resection of the lymph bearing area is a decided advantage. The value of this route is nowhere better illustrated than in cases of carcinoma of the splenic flexures. It is well known that recurrences after resection of this flexure invariably occur in the region of the hilum of the spleen. The usual anterior type of approach renders it difficult to deal with this area, whereas by means of the postero-lateral route described by Doctor Hoag this region is readily accessible.

Doctor Hoag is to be congratulated on the approach which he has devised as it presents so many valuable features in dealing with malignant disease affecting the colon. Exposures of this type warrant a more extensive use than has been accorded to them in the past.

## ADRENAL ENDOCRINOPATHIES IN CHILDHOOD\*

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DISCUSSION by Rieta C. Hough, M.D., San Diego;  
Frank Hinman, M.D., San Francisco; Francis Scott  
Smyth, M.D., San Francisco.

ALTHOUGH Eustachius discovered the adrenal glands in 1563, their importance was not suspected until nearly three hundred years later when Addison, in 1855, showed their relation to the disease known by his name. In the human there are two adrenal glands, which lie embedded in the fat above the kidney on either side. These small triangular or cocked-hat shaped bodies are composed of two parts, cortex and medulla, which, although anatomically united, are morphologically and embryologically distinct structures. The cortex is derived from the mesothelium of the Wolffian ridge, as are also the ovary and testis, while the medulla takes its origin from the intraneural ectoderm that gives rise to the nerve cells of the sympathetic ganglia. In the higher animals the anatomical contiguity of these derivations of the interrenal and chromaffin systems is so intimate that they are fused into a united gland. However, accessory adrenals or aberrant masses of adrenal tissue are met with frequently. These are often quite small, and are found usually in one of four chief locations, in the kidney along the suprarenal vein, near the solar plexus and the inferior surface of the liver, about the uterus, ovary and tube, and in the spermatic cord and corpus Highmori.

### ADRENAL GLANDS A FAVORITE FIELD OF STUDY FOR THE EXPERIMENTAL PHYSIOLOGISTS

Of all the members of the ductless glandular apparatus, the adrenals have been the happy hunting grounds de luxe for the experimental physiologist. Yet, despite the amazing ingenuity of these indefatigable workers, the present state of our knowledge regarding the physiology of the adrenal is still far from satisfactory. Extirpation of one adrenal has little or no apparent effect, although when both are removed death speedily ensues. While much controversy has surrounded the question as to which portion of the adrenal body is essential to life, it has now been demonstrated that death is due to removal or destruction of the cortical substance and not to loss of the medulla. Unfortunately, "up to the present time it has not been possible to produce experimentally any well characterized symptoms associated with adrenal insufficiency. The operator either leaves so much of the gland that the animal survives indefinitely in good health, or takes away so much that it dies quickly, as it would have done if the glands had been totally excised." (Stewart.) No intermediate state between health and death has been achieved. As a result many details of the physiology of the adrenals are still unknown or

\* From the University of California Medical School, San Francisco.

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